



LAURI SEINELÄ

Gastroscope and Colonoscope in Very Old Patients



ACADEMIC DISSERTATION

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LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following original publications, which are referred to by Roman numerals in the text.

- I Seinälä L and Ahvenainen J (2000): Peptic ulcer in the very old patients. *Gerontology* 46: 271–275.
- II Seinälä L, Ahvenainen J, Rönneikkö J and Haavisto M (1998): Reasons for and outcome of upper gastrointestinal endoscopy in patients aged 85 years or more, retrospective study. *BMJ* 317: 575.
- III Seinälä L, Reinikainen P and Ahvenainen J (2003): Effect of upper gastrointestinal endoscopy on cardiopulmonary changes in very old patients. *Arch Gerontol Geriatr* (In press)
- IV Seinälä L, Pehkonen E, Laasanen T and Ahvenainen J (2003): Bowel preparation for colonoscopy in very old patients: a randomized prospective trial comparing oral sodium phosphate and polyethylene glycol electrolyte lavage solution. *Scand J Gastroenterol* 38:216–220.
- V Seinälä L, Rintala J and Ahvenainen J (2002): Attitudes of elderly patients to examinations and treatments of gastrointestinal symptoms. *Scand J Gastroenterol* 37:1471–1472.

ABBREVIATIONS

ASA	Acetosalicylic acid
AV-block	Atrioventricular block
CI	Confidence interval
ECG	Electrocardiography
FEV	Forced expiratory volume
Gastroscopy	Oesophagogastroduodenoscopy
GI	Gastrointestinal
H. pylori	Helicobacter pylori
IQR	Inter quartile range
PEG	Polyethylene glycol
MMSE	Mini-mental state examination
NaP	Sodium phosphate
NNT	Number needed to treat
NSAID	Nonsteroidal anti-inflammatory drug
SaO ₂	Oxygen saturation
SVES	Supraventricular extrasystole
SVT	Supraventricular tachycardia
VES	Ventricular extrasystole
VT	Ventricular tachycardia

1 INTRODUCTION

In the western countries the number of very old people is growing rapidly. In the next 30 years the number of people aged 80 years or more will increase by 140% in Finland. In the year 2030 the number of people aged 80 years or more is estimated to be more than 424 000 in Finland (Statistics Finland 2003). The proportion of the elderly in the use of health care services will increase considerably in the coming years.

With advancing age many diseases, such as peptic ulcer disease and colon cancer, will become more prevalent while symptoms caused by these will become more difficult to interpret. Proper examinations are needed to diagnose the diseases. Gastroscopy and colonoscopy have become the golden standard in investigating abdominal complaints. The limited data concerning these endoscopies in very old patients suggest that the diagnostic yield of endoscopies is also high in these (Lockhart et al. 1985, Chatrenet et al. 1993). Although gastroscopy and colonoscopy are associated with complications, serious complications are rare (Macrae et al. 1983, Reiertsen et al. 1987, Lipscomb et al. 1996, Kavic and Basson 2001, Wexner et al. 2001). Even though the utilization rate for gastroscopy is from two to four times greater in people aged 75 years or more compared to the general population (Mangan et al. 1986), the use of endoscopies has been assessed too cautious in the elderly (Seematter-Bagnoud et al. 1999). Fear of complications and wrong impressions of the willingness of the elderly to be examined properly may lead to unnecessary nihilism and it may also be the main reason for the limited use of endoscopies.

Therefore the aim of the present studies was to research the use of gastroscopy and colonoscopy in the diagnosis of gastrointestinal symptoms of very old people. Indications, clinical findings and the diagnostic yield of gastroscopies were evaluated. The effect of gastroscopy on cardiopulmonary changes was also studied. The safety and efficiency of bowel preparations and colonoscopies were also assessed. Peptic ulcer disease was chosen as an example of a common disease in very old patients. One of the main goals in these studies was to study the patients correspond to daily geriatric practice.

2 REVIEW OF THE LITERATURE

2.1 Symptoms of the gastrointestinal tract

Symptoms attributable to the gastrointestinal tract are common. As much as two-thirds of the population have had at least one functional gastrointestinal syndrome in the preceding three months (Drossman et al. 1993). The symptoms are attributed to four major anatomic regions: oesophageal (42%), gastroduodenal (26%), large intestine (44%), and anorectal (26%). In a Finnish study the incidence of dyspepsia leading to a health centre visit was 21/1000 inhabitants/year (Heikkinen et al. 1996). The frequency of visits to physicians for dyspepsia increased with age.

2.2 Peptic ulcer disease in the elderly

2.2.1 Epidemiology of peptic ulcer disease

The improvement of medical therapy for peptic ulcer disease has significantly changed the treatment of the disease in recent decades. Medical therapy has replaced elective surgery more and more often. In Finland the number of elective operations for peptic ulcers decreased by 89% between the years 1987 and 1997 (Paimela et al. 2002). However, at the same time the number of emergency operations increased by 44%. The availability of histamine-2 receptor antagonists, proton-pump inhibitors, and prostaglandin analogues has not decreased the incidence of ulcer complications in the geriatric population (Connor 1996). It has been suggested that an increase in rates of morbidity and mortality in the elderly may be linked to a delay in diagnosis and treatment (Gilinsky 1990).

The real incidence of peptic ulcer disease remains uncertain because of the nature of the disease, but it is estimated that it occurs in about 10% of adults (Sonnenberg and Everhart 1996). There are 500 000 new diagnoses and 4 million recurrences of gastric and duodenal ulcers yearly in the United States (Kurata 1989). In recent decades many studies have shown a decline in the ulcer rate of gastroscopies in younger age groups, in overall hospital admission rates and in deaths associated with peptic ulcers (Walt et al. 1986, Tilvis et al. 1987, Andersen et al. 1998, Xia et al. 2001, Paimela et al. 2002). However, at the

same time the incidence of peptic ulcer disease and complications caused by it has increased in the elderly. In Finland the number of patients with peptic ulcer disease discharged from Finnish hospitals declined by 27% during the years 1969–84 (Tilvis et al. 1987). Among patients aged 75 years or more the results were the opposite. In the year 1969, the number of patients was 5769. Of these patients 270 (5%) were over 75 years of age. In year 1984 the total number declined to 4201 patients but the amount of elderly patients increased to 830 (20%). Another Finnish study showed an increase of 79% in annual hospital admission rates because of peptic ulcer disease per inhabitants between the years 1972 (38 admissions per 100 000 inhabitants) and 1992 (69 admissions per 100 000 inhabitants) (Paimela et al. 2002). The increase of hospital admission rates during these years was mostly explained by the increase of bleeding gastric ulcers in elderly women (Tilvis et al. 1987, Paimela et al. 2002). A study conducted in England and Wales yielded similar results for the rate of perforated ulcers (Walt et al. 1986). In that study perforation rates for duodenal ulcers rose by a third in middle-aged women and more than doubled in elderly women. Death rates due to ulcer perforation rose in women but fell in men. This was a major finding in a Danish study, too (Andersen et al. 1998). The male to female ratio changed from 1.38 to 1.02 between the years 1981 and 1993. In Finland and Denmark death rates due to peptic ulcers have risen in patients over 65 years of age. In 1984 more than half of the deaths due to peptic ulcers occurred in patients aged 75 years or more (Tilvis et al. 1987). The annual mortality rate from peptic ulcer perforation and haemorrhage increased 62% between the years 1972 and 1992 (Paimela et al. 2002). In the year 2000, 270 patients died of peptic ulcer disease in Finland (Statistics Finland 2000). Of those, 70 (26%) patients were under the age of 65 and 200 (74%) over 65. Of the 270 patients 106 (39%) were over 80 years.

2.2.2 Symptoms

The clinical features of peptic ulcer may vary considerably between individuals. Symptoms caused by it may be atypical and insignificant and the disease may remain undiagnosed.

Epigastric pain relieved by drinking or eating is a classic symptom associated with ulcer. Nausea, vomiting, loss of weight or appetite, melena and lack of symptoms and epigastric pain not relieved by drinking or eating are considered to be atypical symptoms. Atypical symptoms become more frequent and the number of those who do not suffer from epigastric pain increases with age (Clinch et al. 1984, Kemppainen et al. 1997). In these studies about 90% of the patients aged 65 years or less had typical epigastric pain compared

with 35% of patients aged 65 years or more. It also is estimated that approximately half of patients using nonsteroidal anti-inflammatory drugs (NSAIDs) do not have ulcer-related discomfort (Borum 1999). The duration of symptoms of an ulcer is shortest in the elderly and in patients using NSAIDs (Kemppainen et al. 1997). In this study 60% of elderly patients had symptoms for less than four weeks compared with 18% of the younger patients. The short duration of symptoms, advanced age and the absence of typical epigastric pain are common features of bleeding peptic ulcers (Kemppainen et al. 1996).

2.2.3 Complications

The major complications for peptic ulcers are haemorrhage, perforation and obstruction. Over 80% of patients aged 65 years or more have complications associated with ulcers (Tilvis et al. 1987). Bleeding is the most common complication in the elderly with occurrence in 10–15% of ulcer patients. However, in a study by Kemppainen et al. (1997) as many as 50% of the patients aged more than 65 years had bleeding compared with 14% of the patients aged 65 years or less.

Approximately 10% to 20% of patients with bleeding ulcers do not have any preceding symptoms (Cooper et al. 1988). Mortality from peptic ulcer associated with gastrointestinal haemorrhage as a complication of peptic ulcer is four to 10 times greater in the elderly than in younger patients (Gilinsky 1988). In octogenarians, the overall mortality rate from peptic ulcer bleeding is about 25% (Cooper and Neumann 1986, Cooper et al. 1988, Connor 1996). Perforations occur in 5% to 10% of patients with peptic ulcers (Borum 1999). The mortality rate for perforations is high in patients aged 75 years or more being about 50% (Steinheber 1985). Physical findings associated with peritonitis, including fever and leukocytosis, may be diminished or absent in the elderly (McCarthy 1991). This confusing clinical picture often leads to a delay in diagnosis and contributes to the higher mortality rate of complicated peptic ulcers in the elderly (Linder and Wilcox 2001).

2.2.4 Location and size of an ulcer

The distribution of peptic ulcers in the elderly differs from that among younger people. Elderly patients have more gastric ulcers and fewer duodenal ulcers (Clinch et al. 1984, Wyatt et al. 1992). They also have atypical location and greater size of ulcer more often than younger patients (Kemppainen et al. 1997). The location of an ulcer may be

categorised as follows: (1) fundus, (2) corpus, (3) antrum, (4) prepyloric, (5) pyloric, (6) duodenal. Subsites 1–4 consist of gastric ulcers, and 5–6 of duodenal ulcers. Corpus ulcers may be also divided into subgroups as follows: high in the lesser curve of the corpus, low in the lesser curve of the corpus and greater curve of the corpus. Ulcer in the fundus, high in the lesser curve of the corpus and in greater curve of the corpus are considered atypical sites while others are considered typical. Gastric ulcers in the elderly are located more proximally in the stomach compared with gastric ulcers in younger patients (Borum 1999). Gastric ulcers situated in the lesser curve are more often *Helicobacter pylori* (*H. pylori*) positive and larger than prepyloric ulcers (Brody et al. 1992). Prepyloric ulcers seem to be associated with the use of NSAIDs more often than with *H. pylori* infection (Brody et al. 1992). Duodenal ulcers may be larger, with ulcers of diameter greater than 2 cm being reported with increased frequency in the elderly (Connor 1996). Large size and atypical location of the ulcer are associated with bleeding (Kemppainen et al. 1996).

2.2.5 Role of *H. pylori* and the use of NSAIDs

About 70% of patients over 70 years are *H. pylori* positive (Gasparrini et al. 1995). In general population *H. pylori* is present in 90–100% of patients with duodenal ulcers and in 60–90% of patients with gastric ulcers (Brody et al. 1992, Wyatt et al. 1992). In the studies on elderly patients suffering from peptic ulcers the frequency of *H. pylori* varies from 38% to 78%, with a frequency from 24% to 65% in duodenal ulcers and from 39% to 47% in gastric ulcers (Wyatt et al. 1992, Kemppainen et al. 1996, Kemppainen et al. 1997, Pilotto 2001). *H. pylori* positive ulcers are associated with active inflammation of the antral mucosa and a tendency for ulcer recurrence, while *H. pylori* negative ulcers are found to be independently associated with advanced age, bile reflux, NSAID use and intestinal metaplasia (Kemppainen et al. 1998).

Peptic ulceration in the absence of *H. pylori* is more common in the elderly than in younger people (Wyatt et al. 1992, Kemppainen et al. 1998). In a study by Wyatt et al. (1992) peptic ulceration was not associated with *H. pylori* infection in the elderly but was significantly associated with NSAID use.

During the last decade the consumption of NSAIDs has increased 8-fold (Finnish Statistics on Medicines 1996). The United States Food and Drug Administration report estimated that approximately 3% of NSAID users develop serious gastrointestinal complications, resulting in 200 000 cases of bleeding or perforated ulcers and at least 10000 deaths annually. Gastric lesions have been reported in 70% to 80% of patients

ingesting NSAIDs, and ulceration of the gastric or duodenal mucosa occurs in 10% to 30% of patients taking NSAIDs (McCarthy 1998, Singh and Triadafilopoulos 1999). Old age, previous history of ulcer and ulcer complications, concomitant use of corticosteroids, use of high NSAID dose and prolonged NSAID therapy are risk factors for gastrointestinal complications associated with NSAID use (Hawkey 1990, Gabriel et al. 1991).

H. pylori infection is associated with higher prevalence of both gastric and duodenal ulcers in patients receiving NSAIDs (Kemppainen et al. 1996, Pilotto et al. 1997, Voutilainen et al. 2001). In a meta-analysis by Huang et al. (2002) both *H. pylori* infection and NSAID use independently and significantly increased the risk of peptic ulcer and ulcer bleeding. The risk of ulcer in *H. pylori* infected NSAID takers was 61-fold compared with *H. pylori* negative individuals not taking NSAIDs. *H. pylori* infection increased the risk of peptic ulcer disease in NSAID takers 3.5-fold in addition to the risk associated with NSAID use. Similarly, in the presence of risk of peptic-ulcer disease associated with *H. pylori* infection, use of NSAIDs increased the risk of peptic ulcer disease 3.6-fold. *H. pylori* infection and NSAID use increased the risk of ulcer bleeding 1.8-fold and 4.9-fold, respectively. The risk of ulcer bleeding increased to 6.1-fold when both factors were present.

Treatment of *H. pylori* infection in patients with peptic ulcer improved results in the short term follow-up (Murakami et al. 1995, Pilotto et al. 1999). 95% of the patients with peptic ulcers were cured with the treatment and 85% had fewer symptoms after two months. These results, and also a significant improvement in chronic gastritis activity, were seen after one-year follow-up (Pilotto et al. 1998). Two percent of the *H. pylori* eradicated patients and 42% of the *H. pylori* positive patients had an ulcer relapse during one-year follow-up. However, in a study by Brock et al. (2001) no association was detected between the treatment of *H. pylori* infection and a reduction in rehospitalizations or subsequent mortality from peptic ulcer disease. It is of interest that counselling about the risks of using NSAIDs was associated with a reduction in rehospitalization and mortality in elderly patients.

Eradication of *H. pylori* before NSAID therapy reduces the occurrence of NSAID-related peptic ulcers after two to six months (Chan et al. 1997, Chan et al. 2002). In the later study by Chan et al. (2002), the six-month probability of ulcers was 12% in the eradication group and 34% in the omeprazole group. However, in another study no difference was found among NSAID users in the occurrence of ulcers after six months between *H. pylori* positive and negative groups (Hawkey et al. 1998). In that study fewer gastric ulcers healed after eight weeks among eradication-treated patients (72%) than among omeprazole-treated controls (100%).

Although *H. pylori* and the use of NSAIDs are the most important risk factors for peptic ulcer, not all patients have either *H. pylori* infection or use NSAIDs. In studies on elderly patients up to 35% of the patients with ulcers had neither (Brody et al. 1992, Kemppainen et al. 1997). The pathogenesis of ulcer disease is assessed to be the result of an imbalance between aggressive and defensive factors. Acid production does not decrease with age in healthy elderly patients, but the levels of mucosal prostaglandins may decrease with age (Cryer et al. 1992, Isenberg et al. 1995, Hurwitz et al. 1997). Changes in mucosal blood flow and mucosal atrophy in the elderly may weaken the mucosal protection, which may predispose to peptic ulcer (Soll et al. 1991). Age, like *H. pylori* infection, decreases gastric mucosal surface hydrophobicity and the thickness of the gastric mucous gel layer, both of which are essential components of the mucosal defence system (Hackelsberger et al. 1998, Newton et al. 2000).

2.3 Gastroscopy in the elderly

2.3.1 Utilization

In a population-based study in Olmsted County, Minnesota, the use of gastroscopy was evaluated during the 3-year period from 1978 to 1980 (Mangan et al. 1986). The utilization rate was 216 per 100 000 person-years in general United States white population in 1980. The study revealed a greater utilization rate with advancing age among members of both sexes. The utilization rate was from two to four times greater in population aged 75 years or more compared to the general population. In a study conducted in the endoscopy unit of the University Department of Medicine at Bristol Royal Infirmary, United Kingdom, 5% of all gastroscopies and 10% of all emergency gastroscopies were performed on patients aged 80 years or more (Cooper and Neumann 1986). In a study by Seematter-Bagnoud et al. (1999) a multidisciplinary panel consisting of gastroenterologists, internists, a general practitioner and a surgeon studied how gastroscopy is overused and underused in various clinical settings. A total of 2885 patients mean age 49 years from three primary care outpatient clinics, 20 general practices, three gastroenterology practices, two districts and one university hospital participated. One of the main results was that the proportion of overuse was 27% in patients aged 55 years or more compared with 44% in patients aged from 35 to 54 years. By contrast, underuse was estimated to be greater in patients aged 55 years or more (14%) compared with younger patients (5%). The differences in overuse and underuse in different age groups were statistically significant.

2.3.2 Indications

The most common indications in elderly patients for gastroscopy are acute gastrointestinal bleeding, anaemia, abdominal pain and dyspepsia (Gibbins et al. 1974, Jacobsohn and Levy 1977, Lockhart et al. 1985, Cooper and Neumann 1986, Brussaard and Vandewoude 1988, Clarke et al. 2001). Other common indications are oesophageal symptoms, weight loss and vomiting. In earlier studies a positive x-ray lesion also often was a reason for gastroscopy. The proportions of indications in various studies are presented in Table 1. Lockhart et al. (1985) studied which indications more often led to change of management. They found that management was changed in one third to a half of the patients in whom the indication for endoscopy was dyspepsia, bleeding, anorexia or dysphagia. Endoscopy was least helpful in determining the management of iron deficiency anaemia. In a study conducted by Kingston et al. (1999) patients referred with anaemia had lower diagnostic yield (41%) compared with patients with haematemesis (95%), dysphagia (91%), and persistent vomiting (85%). In a Swiss study most of the inappropriate gastroscopies were performed for dyspepsia (Seematter-Bagnoud et al. 1999). In a study by Joosten et al. (1999) the diagnostic value of gastroscopy in patients with iron deficiency with or without anaemia was determined. An upper gastrointestinal tract lesion was found in 49% of the anaemic patients and 56% of the nonanaemic patients.

Indications for gastroscopies have been changed over the last ten years. A study conducted in Australia showed that follow-up of peptic ulcer, bleeding, nausea and vomiting had become less frequent, whereas oesophageal reflux disease and dyspepsia have become more frequent indications for gastroscopy (Xia et al. 2001).

Table 1. Indications (%) for gastroscopies in previous studies on elderly patients.

	Gibbins et al. 1974 n=114	Lockhart et al. 1985 n=100	Cooper and Neumann 1986 n=150	Brussaard and Vandewoude* 1988 n=86	Clarke et al. 2001 n=64
Patients' age (years)	65–89	>70	>80	>80	>85
Oesophageal symptoms	11	10	18	16	14
Abdominal pain	–	–	12	22	–
Dyspepsia	16	45	–	–	6
Anaemia	24	11	10	20	14
Acute bleeding	31	26	45	22	33
Weight loss	–	6	6	–	–
Vomiting	–	–	5	–	–
Other	18	2	–	20	–

*Only the subgroup of patients aged 80 years or more is included. – not mentioned

2.3.3 Clinical findings

The most common clinical findings in gastroscopies in elderly patients are oesophagitis, gastric and duodenal ulcers (Gibbins et al. 1974, Jacobsohn and Levy 1977, Lockhart et al. 1985, Cooper and Neumann 1986, Brussaard and Vandewoude 1988, Clarke et al. 2001). The proportions of different clinical findings in these studies are presented in Table 2. Gastritis, gastric and oesophageal carcinomas and duodenitis were also common findings. Oesophageal varices, gastric polyps, duodenal carcinoma, oesophageal stricture and diverticulum were infrequent findings. From 15% to 34% of gastroscopies yielded normal results.

Wyatt et al. (1992) studied the histopathological types of gastritis in patients aged 70 and over compared to younger adults. The prevalence of chronic gastritis without *H. pylori* infection was higher in the elderly group. In other types of gastritis no difference was found. In a study by Strandberg et al. (1996) the prevalence of chronic gastritis in elderly patients was higher in *H. pylori* positive patients compared with *H. pylori* negative patients. In another Finnish study 400 patients with dyspepsia were investigated (Heikkinen et al. 1995). Oesophagitis was the most common finding in 15%, gastroesophageal reflux without oesophagitis in 12%, duodenal ulcer was found in 9% and gastric ulcer in 4% of patients.

Table 2. Major clinical findings (%) at gastroscopies in previous studies on elderly patients.

	Gibbins et al. 1974 n=114	Lockhart et al. 1985 n=100	Cooper and Neumann 1986 n=150	Brussaard and Vandewoude* 1988 n=86	Clarke et al. 2001 n=64
Patients' age (years)	65–89	>70	>80	>80	>85
Oesophagitis	4	16	21	19	7
Oesophageal carcinoma	4	3	6	–	–
Gastritis	–	7	6	16	12
Gastric ulcer	16	17	15	14	19
Gastric carcinoma	18	12	14	5	–
Duodenitis	–	3	1	7	–
Duodenal ulcer	7	9	11	15	5
Normal	34	33	16	15	26

*Only the subgroup of patients aged 80 years or more is included. –not mentioned

2.3.4 Outcome

Lockhart et al. (1985) showed that upper gastrointestinal endoscopy has a high diagnostic yield (77% or more) in the elderly. In their study the patient's management was changed in half of the elderly patients in whom an appreciable abnormality was diagnosed by endoscopy. Cooper and Neumann (1986) considered that 83% of 208 gastroscopies performed on patients aged 80 years or more were helpful. An endoscopy was assessed to be helpful if it revealed the cause of the patient's symptoms or actively aided the patient's management. In an earlier study by Gibbins et al. (1974) useful information was obtained on the majority of patients (93%). In a study conducted by Brussaard and Vandewoude (1988) a prospective comparative analysis of endoscopies showed a lower percentage of normal endoscopies in older patients. In a Finnish study 936 consecutive patients underwent gastroscopy in primary health care (Keyriläinen and Sipponen 1997). About half of all patients had clinically significant diagnostic findings. In this study middle-aged and elderly patients also had more clinical findings compared to younger. In a study conducted in Ireland (Kingston et al. 1999) diagnostic yield was 65% in patients under 45 years and 71% in patients over 45 years. In that study diagnostic yield was significantly lower for medical patients (59%) than for surgical patients (72%).

2.3.5 Non-cardiopulmonary complications

Gastroscopy is associated with serious complications in 0.02–1.8% of examinations and deaths in 0.005–0.5% of examinations (Silvis et al. 1976, Davis and Graham 1979, Lieberman et al. 1985, Reiertsen et al. 1987, Lee et al. 1995b). In a study conducted by Reiertsen et al. (1987) 7314 diagnostic and 440 therapeutic gastroscopies were performed during a five-year period (1980–1984). Therapeutic gastroscopies were associated with non-fatal complications in eight out of 440 (1.8%) procedures and included two (0.5%) deaths compared with four non-fatal complications (0.05%) and one death (0.01%) in diagnostic procedures. The majority of complications were due to perforation, haemorrhage and cardiopulmonary problems (Levy and Abinader 1977, Clarke et al. 2001, Kavic and Basson 2001).

Perforation during gastroscopy is estimated to occur at a frequency of 0.02% to 0.2% (Zubarik et al. 1999). It is more likely to occur during therapeutic manipulation. Risk of significant haemorrhage accompanied by an appreciable drop in hematocrit and clinical signs of volume depletion is increased in the patients with previous gastric surgery

(Domellöf et al. 1983, Rodney et al. 1990). However, the reported complication rates are less than 0.15%. Aspiration pneumonia is the most significant infectious complication of gastroscopy (Lipper et al. 1991). It occurs most often in patients with gastrointestinal haemorrhage and in patients with many underlying comorbidities.

2.3.6 Cardiopulmonary complications

Gastroscopy causes haemodynamic stress by inducing transient elevation of blood pressure, pulse rate and rate pressure product, and the serum concentrations of adrenaline and noradrenaline rise (Bowling et al. 1993, Oei-Lim et al. 1998). After gastroscopy the level of human atrial natriuretic peptide increases in the elderly (Shimamamoto et al. 1999). In sedated patients haemodynamic stress caused by the increase of rate pressure product is minor (Murray et al. 1991, Rosenberg et al. 1996, Oei-Lim et al. 1998).

The prevalence of acute cardiovascular complications of endoscopy is low. In a study conducted by Lee et al. (1995b) 21946 endoscopies were reviewed. Cardiopulmonary complications were observed in 31 (0.14%) cases. The occurrence was ten times higher in colonoscopies (0.4%) compared with gastroscopies (0.04%). Cardiopulmonary problems are found more frequently in elderly patients with heart diseases, in patients with significant oxygen desaturation, and in those with poor tolerance (Levy and Abinader 1977, Mathew et al. 1979, Katz et al. 1981, Lieberman et al. 1985, McAlpine et al. 1990, Murray et al. 1991, Lee et al. 1995a, Schenck et al. 2000, Yazawa et al. 2000). In patients with heart disease the incidence of serious arrhythmias and ST changes has been found to be at least twofold compared with the patients with no heart disease (Pyörälä et al. 1973, Mathew et al. 1979, Lieberman et al. 1985, McAlpine et al. 1990). In Matthew's study (1979) arrhythmias were detected in 39% of endoscopies. However, arrhythmias were concentrated on elderly patients, as many as 75% of elderly patients had arrhythmias. However, in many studies no significant increase in ECG changes were observed during endoscopy even though the majority of patients had heart disease (Bowling et al. 1993, Strandberg et al. 1993, Wilcox et al. 1993).

Arterial oxygen desaturation occurs frequently during gastroscopy. In a study by Dhariwal et al. (1992), age of 65 years or more, haemoglobin under 100g/l and body mass index greater than 28 kg/m² were identified as independent risk factors for desaturation in gastroscopies performed with premedication. However, in a study conducted by Iwao et al. (1994) age, gender, smoking, haemoglobin level, body mass index or total endoscopy time were not related to the degree of oxygen desaturation. In patients with heart disease oxygen

desaturation occurs more often in those with a low cardiac index or in those who belong to class II or higher of the New York Heart Association functional classification (Yazawa et al. 2000).

The influence of sedation on oxygen desaturation is well known. Severe hypoventilation as a consequence of deep sedation is the most frequently reported cause of cardiac arrest and death following gastroscopy (Quine et al. 1995). Kinoshita et al. (1991) studied the influence of sedation with meperidine (petidinehydrochloride) on arterial oxygen saturation (SaO₂). SaO₂ fell both in the sedated group and in the non-sedated group at the beginning of endoscopy. Thereafter SaO₂ returned to its basal value during gastroscopy in the non-sedated group, while it remained at a lower level in the meperidine-pretreated patients. In the study conducted by Lieberman et al. (1985) a group of patients were pretreated with diazepam. Oxygen desaturation was greater in the group with diazepam, especially in patients aged 60 years or more. In that study patients with severe chronic obstructive pulmonary disease (FEV1 < 50% of predicted) were more likely to experience significant desaturation. Bell et al. (1987a) obtained similar results with patients sedated with midazolam. After intravenous midazolam SaO₂ fell 3.3% followed by an additional 3.1% decrease during gastroscopy. Oei-Lim et al. (1998) compared cardiovascular responses during gastroscopy using sedation with midazolam or propofol. Both drugs contributed to hypoxemia, but midazolam decreased SaO₂ for a longer time than propofol.

In a later study Bell et al. (1987b) showed that arterial oxygen desaturation is prevented by supplemental oxygen via nasal cannulae during gastroscopy. Patients were given oxygen 2 litres per minute throughout the procedure and no significant desaturation occurred. This finding has subsequently been confirmed in many studies (Reed et al. 1993, Hebbard et al. 1994, Patterson et al. 1995, Fisher et al. 1998, Wang et al. 2000). Hebbard et al. (1994) showed that both intranasal and intrapharyngeal oxygen supplementation were of similar efficacy in decreasing the incidence of arterial oxygen desaturation.

Rozen et al. (1981) studied the influence of endoscope diameter on arterial oxygen tension. They found that during the examination the least suppression of arterial oxygen tension was caused by combining the short-acting narcotic, fentanyl, with a narrow diameter pediatric endoscope. However, after meperidine premedication no difference was found between the narrow and normal diameter endoscope. In a study conducted by Cooper et al. (1995) no difference was found in oxygen saturation between endoscopes of different diameters.

In previous studies ST segment changes have often been found in ECG during endoscopy, Table 3. Such changes are considered a sign of myocardial ischaemia. A change, usually a drop, of ST segment level of 1mm or more lasting at least 60 seconds is

considered clinically significant. In a study by Murray et al. (1991) a significant correlation was found between ST segment depression and hypoxemia. However, in that study ST changes were mostly under 1mm. In the studies by Bowling et al. (1993) and Rosenberg et al. (1996) oxygen therapy had no significant effect on the occurrence of ST segment depression during gastroscopy. The results of the later study suggest that tachycardia is a more important factor than arterial hypoxemia in the pathogenesis of ST depression during gastroscopy. The study by Yazawa et al. (2000) supports this finding. In their study tachycardia without desaturation occurred in all patients with heart disease who experienced ST segment depression. Schenck et al. (2000) found that silent ischaemia occurs in over 40% of patients with stable coronary heart disease during gastroscopy and that this is related to tachycardia. However, in a study by Murray et al. (1991) no correlation was found between ST segment depression and heart rate or rate pressure product.

Arterial oxygen desaturation and ST level changes may also occur after gastroscopy (Pyörälä et al. 1973, Bowling et al. 1993). In the latter study oxygen saturation was significantly lower 60 minutes after gastroscopy than at baseline before the procedure. In both studies gastroscopies were performed with midazolam premedication, which may contribute to the prolonged desaturation time.

Arrhythmias have been detected in 38% to 91% of patients during gastroscopy according to previous studies (Pyörälä et al. 1973, Mathew et al. 1979, McAlpine et al. 1990, Bowling et al. 1993, Strandberg et al. 1993, Wilcox et al. 1993), Table 3. Patients with heart disease and with chronic pulmonary disease are more likely to develop

Table 3. Occurrence (%) of arrhythmias and ST changes during gastroscopies in previous studies.

	Pyörälä et al. 1973 n=101	Mathew et al. 1979 n=52	Bowling et al. 1993 n=103	Strandberg et al. 1993 n=54	Wilcox et al. 1993* n=25
Patients' age in years (mean)	– (54)	23–84(60)	60–89(71)	75–86	40–91(66)
Supraventricular extrasystoles	13	22	40	96	72
Supraventricular tachycardia	–	–	12	6	8
Ventricular extrasystoles	22	29	31	94	51
Bigemina	–	–	6	–	–
Ventricular tachycardia	–	–	–	15**	4
Atrioventricular block	–	2	–	–	0
ST-T change	21	8	2	20	4

*includes four endoscopic retrograde cholangiopancreatographies and eight colonoscopies,

**3–5 consecutive ventricular extrasystoles, – not mentioned

arrhythmias than patients without these diseases (Mathew et al. 1979, McAlpine et al. 1990). Although the majority of arrhythmias occur during gastroscopy, gastroscopy is also associated with an increased number of arrhythmias after the procedure (Fujita and Kumura 1974, Levy and Abinader 1977, McAlpine et al. 1990). However, the increase of these after the procedure has not been statistically significant in these studies. Sinus tachycardia occurs in up to 80% of patients (Pyörälä et al. 1973, Levy and Abinader 1977, Murray et al. 1991). In most studies it is not considered to be an arrhythmia (Fujita and Kumura 1974, Mathew et al. 1979, McAlpine et al. 1990, Bowling et al. 1993, Yazawa et al. 2000). Supraventricular extrasystoles occur in 13–96% of patients (Fujita and Kumura 1974, Levy and Abinader 1977, Mathew et al. 1979, McAlpine et al. 1990, Murray et al. 1991, Bowling et al. 1993, Yazawa et al. 2000). In a study conducted by Bowling et al. (1993) SVES occurred in fewer patients with supplementary oxygen. No correlation for SaO₂ and other ECG abnormalities was shown in the study. Supraventricular tachycardia has been reported in approximately 10% of patients, ventricular extrasystoles in 22–94% of patients, bigemina or trigemina in 6% of patients in previous studies. First-degree heart block and bundle branch blocks are rare findings in those with less than 5% occurrence. Usually ECG changes are self-terminating and resolved spontaneously during recovery (McAlpine et al. 1990, Murray et al. 1991, Bowling et al. 1993). In studies comparing ECG abnormalities between different time periods (pre-, per- and postgastroscopy) significant differences have seldom been found (Bowling et al. 1993, Strandberg et al. 1993, Wilcox et al. 1993).

2.4 Colonoscopy in the elderly

2.4.1 Indications

The most common indications for colonoscopies in previous studies have been gastrointestinal blood loss and anaemia, change in bowel habits and abdominal pain (Khanna 1987, Chatrenet et al. 1993, Burtin et al. 1995, Ure et al. 1995, Lagares-Garcia et al. 2001), Table 4. A relevant lesion was found in over half of the examinations when indications were either anaemia or rectal bleeding. If the indication for examination was a change in bowel habit or weight loss a relevant finding was found in 25% of cases (Chatrenet et al. 1993, Clarke et al. 2001). In patients aged 80 years or more undergoing colonoscopy because of rectal bleeding, carcinoma of the large intestine was found in 29% of cases compared with 10% of non-bleeders (Bat et al. 1992). Colonoscopy is considered a better screening method for colon cancer compared with sigmoidoscopy because it also

Table 4. Indications (%) for colonoscopies in previous studies on elderly patients.

	Khanna 1987 n=117	Chatrenet et al. 1993 n=200	Ure et al. 1995 n=354	Clarke et al. 2001 n=95	Lagares-Garcia et al. 2001 n=103
Patients' age in years (mean)	60–91(73)	>80(84)	>70 (77)	>85 (87)	>80(83)
Gastrointestinal bleeding	21	13	34	26(41*)	84**
Anaemia	8	41	–	9	–
Change in bowel habit	20	29	7	6	–
Abdominal pain	10	5	11	1	44***
Weight loss	–	–	3	2	–
Control	21	5	25	32	6

*if haeme-occult positive stool are included, ** blood in stool, ***includes all abdominal and rectal complaints, – not mentioned

identifies proximal lesions (Gannon et al. 2002). In patients with iron deficiency the diagnostic value of colonoscopy was found to be better in anaemic than in non-anaemic patients, a lower gastrointestinal lesion was found in 32% of anaemic patients and 16% of non-anaemic patients (Joosten et al. 1999). Among the group of patients aged 80 years or more the indication for colonoscopy is more often blood in the stool and suspicion of vascular disease in the colon than in younger patients (Lagares-Garcia et al. 2001).

2.4.2 Clinical findings

Elderly patients have been more likely than younger patients to have an abnormal colonoscopy finding (Ure et al. 1995, Lagares-Garcia et al. 2001, Mulcahy et al. 2002), Table 5. Normal examinations have been obtained for about one third of patients (Khanna 1987, Chatrenet et al. 1993, Burtin et al. 1995, Ure et al. 1995, Lagares-Garcia et al. 2001). Diverticulosis and various polyps have been common findings at colonoscopy in the elderly (Ure et al. 1995). Malignant colorectal tumors, vascular and diverticular diseases are found more commonly in the elderly than in younger patients (Ure et al. 1995, Lagares-Garcia et al. 2001). Interestingly, colitis is observed in approximately 6% of examinations in elderly patients.

Table 5. Major clinical findings (%) at colonoscopies in previous studies on elderly patients.

	Khanna 1987 n=117	Chatrenet et al. 1993 n=200	Ure et al. 1995 n=354	Clarke et al. 2001 n=95	Lagares-Garcia et al. 2001 n=103
Patients' age in years (mean)	60–91(73)	>80(84)	>70 (77)	>85 (87)	>80(83)
Diverticulosis	43	21	31	10	52
Polyps	21	20	24	23	19
Carcinoma	13	15	6	13	16
Vascular disease	–	4	1	3	15
Colitis	20	4	2	4	0
Normal	22	34	26	44	71

– not mentioned

2.4.3 Outcome

The diagnostic yield of colonoscopy is high in the elderly. From 40% to 78% of examinations are considered helpful (Khanna 1987, Chatrenet et al. 1993). In studies in which the yield of colonoscopy has been compared between different age groups the oldest group have had the best diagnostic yield (Khanna 1987, Ure et al. 1995, Lagares-Garcia et al. 2001, Mulcahy et al. 2002). However, in the study conducted by Ure et al. (1995) separate analysis of colonoscopies in the subgroup of patients aged 80 years or more did not reveal any significant differences from the group aged 70 years or more.

The rate of successful colonoscopies varies from 52% to 91% in previous studies (Khanna 1987, Bat et al. 1992, Chatrenet et al. 1993, Burtin et al. 1995, Ure et al. 1995, Lipscomb et al. 1996, Lagares-Garcia et al. 2001). It usually is lower in the elderly (Bat et al. 1992, Ure et al. 1995, Lipscomb et al. 1996). The main reasons for the incomplete examinations in previous studies have been poor preparation and technical difficulties caused mostly by diverticular disease.

2.4.4 Complications

Colonoscopy is a quite safe and well tolerated procedure in the elderly. The rate for serious complications is about 0.2% and for mortality at most 0.1% in general population (Macrae et al. 1983, Reiertsen et al. 1987, Lipscomb et al. 1996, Kavic and Basson 2001, Wexner et al. 2001). These rates are usually higher in studies on elderly people. In the study by Ure et

al. (1995) 6.8% of patients aged 70 years or more had some complication compared with 4.6% of the patients aged less than 70 years of age. In the study by Lagares-Garcia et al. (2001) the rate of complications in octogenarians was 0.9% compared to 0.6% and 1.1% in patients aged 17–49 years and 50–79 years respectively. Usually most serious complications occur in elderly patients (Lee et al. 1995b, Ure et al. 1995, Lagares-Garcia et al. 2001, Wexner et al. 2001). However, the overall morbidity of colonoscopy, which also includes all minor complications, is similar in elderly and in younger patients (DiPrima et al. 1988, Steffes et al. 1990, Bat et al. 1992, Ure et al. 1995). A history of cardiac and pulmonary disease predicts an increased risk of complications during colonoscopy (Steffes et al. 1990, Lee et al. 1995b). However, this finding is open to question. In the study by DiPrima et al. (1988) the presence of cardiac, pulmonary, liver or kidney disease, or previous abdominal or pelvic surgery was not found to be associated with an increased incidence of complications.

The overall incidence of perforation in colonoscopies varies between 0.1% and 0.5% (Silvis et al. 1976, Macrae et al. 1983, Reiertsen et al. 1987, Wexner et al. 1998, Wexner et al. 2001). However, in studies on patients aged 65 years or more, perforation rates vary from 0.5% to 1% (DiPrima et al. 1988, Chatrenet et al. 1993, Clarke et al. 2001). Haemorrhage occurs in 0.07% to 3.6% of patients after polypectomy (Macrae et al. 1983, DiPrima et al. 1988, Wexner et al. 2001). The incidence of delayed bleeding, 1–14 days after the procedure, is greater in the elderly (Macrae et al. 1983, DiPrima et al. 1988).

Colonoscopy is also associated with cardiovascular complications such as: myocardial infarction, vasovagal reaction, arrhythmias and congestive heart failure. The overall incidence of cardiopulmonary complications varies between 0.12% and 1.32% (Macrae et al. 1983, DiPrima et al. 1988, Lee et al. 1995b, Wexner et al. 2001). Serious complications occur mainly in patients with heart disease.

Colonoscopy is tolerated equally or better with analgesia and sedation than without them (Chatrenet et al. 1993, Ristikankare et al. 1999). Colonoscopy is technically more difficult with elderly patients, but it is still tolerated better among them (Ristikankare et al. 2001). The use of analgesia and sedation is lower in octogenarians and older patients than in younger patients (Chatrenet et al. 1993, Lagares-Garcia et al. 2001). The use of sedation, for example midazolam, may contribute to the occurrence of adverse cardiovascular events (Ristikankare et al. 2000a, Ristikankare et al. 2000b).

Other rare complications associated with colonoscopy procedure in the literature are endocarditis, septicaemia, and splenic injury (Macrae et al. 1983, Kavic and Basson 2001).

2.4.5 Bowel preparation for colonoscopy

The most common reason for unsuccessful colonoscopy is inadequate bowel preparation. The frequency of inadequate preparations varies from 9% to 67% between the studies (Vanner et al. 1990, Marshall et al. 1993b, Cohen et al. 1994, Afridi et al. 1995, Golub et al. 1995, Clarkston et al. 1996, Ness et al. 2001). A later colonoscopy starting time, a reported failure to follow preparation instructions, inpatient status, a procedural indication of constipation, use of tricyclic antidepressants, male gender, and a history of liver cirrhosis, stroke or dementia are predictors of an inadequate colon preparation (Ness et al. 2001). The influence of age on colonic preparations is controversial. In the study by Adams et al. (1994) the quality of preparation was found to correlate with patients' age, whereas in the studies by DiPalma et al. (1986) and Ness et al. (2001) no correlation was found.

The most common agents used for the cleansing of the colon are polyethylene glycol electrolyte lavage (PEG) and sodium phosphate (NaP) solutions. Numerous alternatives have also been used. These include bisacodyl, senna, magnesium citrate, castor oil, sodium picosulphate and various combinations of these agents.

PEG has been the most used cleansing agent in recent years. It is a nondigestible, nonabsorbable and osmotically balanced lavage solution which cleanses the colon by washout of ingested fluid. At least three litres of it is needed for the cleansing of the colon, but the most common amount used is four litres. The administration of a relatively large volume does not result significant changes in fluid and electrolyte balance. PEG solution contains either 59mg polyethylene glycol 3350 in ml or 60mg polyethylene glycol 4000 in ml, and 5.68mg sodium sulphate in ml, 1.46mg sodium chloride in ml, 0.75mg potassium chloride in ml and 1.68mg sodium bicarbonate in ml. Difficult renal insufficiency and congestive heart failure, perforation or occlusion of the gastrointestinal tract, and recent myocardial infarction are contraindications for this. Many elderly patients have difficulties in drinking the large quantity that is necessary for proper cleansing. PEG preparation may also cause adverse effects such as nausea and abdominal pain in some patients. Thus adequate preparation may not be achieved.

NaP has also been proven to be an effective and well tolerated agent in the cleansing of the colon. Its advantage is in the smaller quantity of fluid needed for good cleansing. A tablet formula of this preparation has also been developed. NaP has a high osmotic laxative effect. It cleanses the colon by its cathartic action, fluid is shifted from the plasma to the bowel. Because of the high sodium load and effect of NaP as an osmotic cathartic, it may also alter serum electrolytes and extracellular fluid status. NaP solutions used for preparations include two 45 ml doses. Each of these contains 24.4 g of sodium phosphate

dibasic $[\text{Na}(\text{Po}_4)_2]$ and 10.8 g of sodium phosphate monobasic $[\text{NaPo}_4]$. Contraindications for the use of NaP are very similar to PEG, including renal insufficiency, ascites, occlusion of gastrointestinal tract, symptomatic congestive heart failure, and recent myocardial infarction. In most studies it is reported to be less expensive than PEG. In studies conducted in the USA and Canada, PEG solution was from four to ten times more expensive than NaP (Vanner et al. 1990, Golub et al. 1995, Clarkston et al. 1996). In Finland the difference is less marked.

Many studies have shown equal efficiency for PEG and NaP preparations (Afridi et al. 1995, Golub et al. 1995, Henderson et al. 1995, Clarkston et al. 1996, Aronchick et al. 2000). However, there are some studies in which NaP has been assessed as preferable to with PEG (Vanner et al. 1990, Cohen et al. 1994, Frommer 1997, Arezzo 2000, Young et al. 2000). Some arguments have been evinced to account for differences. In a study by Vanner et al. (1990) 20% of the patients in the PEG group were unable to complete the preparation. In some studies the amount of PEG solution used has been less than four litres. (Frommer 1997, Young et al. 2000) In a study by Young et al. (2000) patients received only two litres of PEG preceded by a stimulant laxative bisacodyl and NaP was found superior to PEG. There has been doubt that a less than four litres of PEG is less effective even with bisacodyl. However, there are studies reporting similar efficacy in cleansing the colon with two litres of PEG with or without bisacodyl compared with standard four litres PEG preparations (Adams et al. 1994, Mukai et al. 2000).

Preparations have been rated as excellent or good in 33–92% of cases and fair or poor in 8–67% of cases with PEG and 80–91% and 9–20% with NaP, respectively (Vanner et al. 1990, Cohen et al. 1994, Golub et al. 1995, Henderson et al. 1995, Clarkston et al. 1996, Young et al. 2000). In a study by Henderson et al. (1995) colon cleansing with PEG was rated better for the right side of the colon, but overall cleansing did not differ significantly. PEG preparation was associated with more residual liquid throughout the colon, where as NaP was associated with more faeces retained in the right side of colon. These findings are controversial. In some studies the results are the opposite (Vanner et al. 1990, Cohen et al. 1994), but not in all (Clarkston et al. 1996).

The timing for the use of different cleansing agents differs between studies. Patients usually start to receive PEG preparation on the day before the examination. In a study by Church (1998) patients received four litres of PEG solution on the day of colonoscopy, starting at eight a.m. The examinations were performed at afternoon. Compared with the usual method, in which preparation is started at six p.m on the day before the procedure, cleansing was significantly better. However, 20% of patients were unable to complete the whole preparation. NaP preparations are also started on the previous day, but in many

studies half of the NaP solution is received on the morning of the examination. Marshall et al. (1993a) conducted a study in which both doses of NaP were ingested at once in the evening before the examination. Given in this manner NaP yielded inferior results compared with PEG preparation. Henderson et al. (1995) also gave NaP preparations on the day before colonoscopy, but they divided the NaP solution into two doses. In the study by Afridi et al. (1995) patients also ingested NaP in this manner, but they also used bisacodyl. The results of the preparations were assessed as equal in both manners as in the study by Frommer (1997). In that study one group received 45ml of NaP twice on the day before colonoscopy, the second group received 45ml of NaP on the evening before colonoscopy and the other 45ml in the morning of the examination, third group received three litres of PEG on the day before colonoscopy. Cleanliness of the bowel was significantly better in the second group compared to the other groups.

NaP preparation is easier to ingest than PEG preparation. The entire preparation is ingested in 96–100% of cases in NaP groups compared with 19–91% of cases in PEG groups (Vanner et al. 1990, Cohen et al. 1994, Afridi et al. 1995, Golub et al. 1995, Clarkston et al. 1996, Aronchick et al. 2000, Young et al. 2000). Patients in the NaP group usually report less overall discomfort from their preparation compared to the PEG group (Young et al. 2000). NaP preparations are easily tolerated or acceptable in 73–85% of cases and PEG in 31–59% of cases (Vanner et al. 1990, Aronchick et al. 2000, Young et al. 2000).

Colonoscopy is performed more than once on many patients. Therefore the compliance of the patient is an important factor. The percentage of patients who are willing to retake the preparation if needed is 53–87% in NaP groups and 19–85% in PEG groups (Brady et al. 1985, Cohen et al. 1994, Golub et al. 1995, Aronchick et al. 2000, Young et al. 2000). In studies in which patients had undergone a previous colonoscopy with PEG preparation and a re-examination has been made with NaP preparation, almost all patients have expressed a preference for taking NaP, despite the fact that in some studies NaP has been reported to cause more adverse effects (Vanner et al. 1990, Frommer 1997).

NaP and PEG preparations are often associated with such adverse effects as nausea, vomiting, abdominal cramps, faecal incontinence, dizziness, insomnia, abdominal fullness, and palpitations. In many studies no significant difference has been found between these agents (Vanner et al. 1990, Cohen et al. 1994, Afridi et al. 1995, Golub et al. 1995, Clarkston et al. 1996, Aronchick et al. 2000, Young et al. 2000). However, some minor differences have been reported. Nausea and vomiting are more common during NaP than PEG preparations with occurrences of 16% and 7% in the NaP group and 4% and 1% in the PEG group respectively (Frommer 1997). However, the tablet formula of NaP causes

significantly less nausea than PEG or NaP solutions (Aronchick et al. 2000). Metoclopramide has not shown advantage in preventing nausea, which is associated with PEG preparations (Brady et al. 1985, Golub et al. 1995). Abdominal fullness is more common with PEG preparations than with NaP preparations (Cohen et al. 1994, Golub et al. 1995).

The osmotic properties of NaP raise concerns about potential intravascular volume depletion. This risk has been studied by monitoring vital signs, total body weight and blood tests of serum potassium, sodium and hematocrit. 20–28% of patients receiving NaP and 20–45% receiving PEG develop significant postural blood pressure changes or increase in pulse rate (Vanner et al. 1990, Afridi et al. 1995). Total body weight decreases by one to two kilograms during the preparation (Vanner et al. 1990, Cohen et al. 1994). Preparation with NaP is associated with an increase in the levels in serum sodium, chloride, phosphate, hematocrit and in serum osmolality whereas the levels of serum potassium and calcium decrease (Vanner et al. 1990, Cohen et al. 1994, Clarkston et al. 1996). NaP preparation-induced hypokalemia occurs in approximately 20–30% of patients (Vanner et al. 1990, Clarkston et al. 1996).

The effect of preparation on cardiac arrhythmias has also been evaluated in some studies. During the preparation period or during colonoscopy no increase has been found in the frequency of VES or in the occurrence of bradycardia, SVT, VT in patients receiving PEG or NaP preparations (Clarkston et al. 1996).

In a meta-analysis of eight trials Hsu and Imperiale (1998) compared the PEG and the NaP preparations of over 1200 colonoscopies. The mean age of the patients in the studies was 57 years. NaP was superior to PEG in many features. Patients with NaP preparation had a lower risk of inability to complete the preparation. The pooled relative risk of failure to complete the preparation was 0.23 (95% CI 0.18–0.28), in favour of NaP. The number needed to treat (NNT) was 7, meaning that seven patients would need to be treated with NaP preparation to have one additional patient complete the preparation. An excellent quality of preparation was achieved more often with NaP. The frequency of acceptable preparations was higher with NaP. Re-examinations due to inadequate preparations were made in 3% of cases with NaP and in 8% with PEG respectively. The direct costs of colonic examination were estimated at 465 USD for NaP and 503 USD for PEG.

3 AIMS OF THE STUDY

The purpose of the study was to obtain further information on the use of gastroscopy and colonoscopy in the diagnosis of the gastrointestinal symptoms of very old people. Peptic ulcer disease was studied as a common disease of the gastrointestinal tract in very old patients. In the studies patients were selected to represent the whole spectrum of geriatric practice. Whenever possible concomitant diseases were not exclusion criteria.

The articles included in the study were intended to address the following problems:

1. What are the specific features of peptic ulcer disease in very old patients (I)?
2. What are the reasons for and outcome of upper gastrointestinal endoscopy in very old patients (II)?
3. Can gastroscopy be regarded as a useful and safe examination in very old patients (II, III)?
4. Which of the methods commonly used for bowel preparation is safer, more efficient and more easily tolerated in patients aged 80 years or more, polyethylene glycol electrolyte lavage solution or sodium phosphate (IV)?
5. What are the attitudes of elderly peoples to examinations and treatments of gastrointestinal symptoms (V)?

4 SUBJECTS AND METHODS

4.1 Study design

The design of Studies I and II was retrospective. In these studies files from diagnostic gastroscopies in the geriatric department of the Tampere City Hospital during the years 1993–1998 were reviewed. Information was gathered from patients and endoscopy unit files. Study III was prospective. In Study III Holter ECG monitoring was performed on hospitalized patients who underwent diagnostic gastroscopy in the Geriatric Department of Tampere City Hospital during the years 1996–1997. Study IV was a randomised prospective trial. Consecutive inpatients aged 80 years or more were randomised to receive either NaP (Phosphoral[®], Ferring) or PEG solutions (Colonsteril[®], Orion, Clean-Prep[®], Sabora Pharma). Study V was a prospective study. Elderly people were asked about their attitudes to gastroscopy and colonoscopy and more generally, the way they hoped to be examined and treated if they were to have a gastrointestinal problem.

4.2 Definitions and rating scales

In Study I an ulcer was defined as the presence of a mucosal crater; erosions were not included. Ulcers were divided by their localisation into the following categories: 1) fundus, 2) corpus, 3) antrum, 4) prepyloric region, 5) pyloric and 6) duodenal. An ulcer was considered to be prepyloric if it was located within three cm of the pyloric ring. These were studied as a group of their own. Subsites 1–3 consisted of other gastric ulcers, and subsites 5 and 6 of duodenal ulcers. All upper abdominal pain, not only that relieved by eating or drinking, were accepted as epigastric pain. The complications were: deterioration of health, vomiting, loss of weight, melena, hematemesis and anaemia.

In Study III the criteria for heart disease were at least two of the following: history of ischaemic or valvular heart disease, ECG evidence of ischaemia or myocardial infarction or evidence of cardiomegaly on a chest X-ray. Ventricular tachycardia (VT) was defined as three or more consecutive ventricular extrasystoles at a rate greater than 120/minutes. Supraventricular tachycardia (SVT) was defined as 3 or more consecutive beats at a rate greater than 130/minute. ST segment changes were analysed 60 mseconds after J-point and

considered abnormal if ST segment changes were greater than 0.1mV and lasted at least one minute.

In Study IV the clinical indicators for dehydration used were as recommended by Gross et al. (1992): tongue dryness, dryness of the mucous of the membranes of the mouth, upper body muscle weakness, confusion, difficulty with speech and sunken eyes. A postural drop in systolic blood pressure greater than 10mmHg was considered clinically significant. In that study patients graded their tolerance of preparation and willingness to repeat the regimen received just before colonoscopy as follows: 1 = extremely unpleasant, 2 = slightly unpleasant, 3 = moderately easy and 4 = easy. The severity of specific symptoms such as abdominal pain, nausea, dizziness, and faecal incontinence were graded during preparation and colonoscopy from 0 to 3 (0 = no symptoms, 1 = mild, 2 = moderate, 3 = severe). Taste was ranked from 0 to 3 (0 = good, 1 = tolerable, 2 = bad, 3 = unacceptably bad). The preparation was assessed by endoscopists as follows: 1 = excellent (small volume of clear liquid), 2 = good (large volume of clear liquid), 3 = fair (moderate amounts of stool that could be suctioned away), 4 = poor (large amounts of stool that could not be suctioned away).

4.3 Materials and methods

In Study I files from altogether 408 diagnostic gastroscopies performed for the patients aged 80 years or more were reviewed. Patients whose ulcer was caused by cancer and patients receiving warfarin treatment were excluded. After the exclusion 65 patients with peptic ulcer were included. The presence of *H. pylori* was recorded by the pathologist from Giemsa-stained histological slides taken from the antrum and from the corpus.

In Study II one hundred and ninety gastroscopies performed on the patients aged 85 years or more were reviewed. After the exclusion of re-endoscopies (16), and failed intubations (7) and inadequate records (13), 154 gastroscopies were included. To avoid hypoxia, supplemental oxygen was given but premedication, sedation, and pharyngeal lidocaine spray were not used during these examinations.

In Study III Holter monitoring (Oxford Mediloc 4500) was begun in the afternoon before gastroscopy and maintained for 24 hours. Four recordings were excluded because of technical problems, so that the final series consisted of 33 patients. Three of the patients had atrial fibrillation. They were excluded from the analysis for supraventricular arrhythmias. Changes in arterial oxygen saturation were monitored from the right index finger by pulse oximetry (Datex Satelite Trans OSP-200). Supplementary oxygen was

given via the nasal cannulae. It was started 5 min before gastroscopy and ended shortly after it. All patients were lying on the left side and no premedication, local anaesthetic spray or sedation was used.

The occurrence and number of ECG changes were studied throughout the 24-hour monitoring and from one hour before and after gastroscopy. In order also to analyse arrhythmias during gastroscopy as number per hour, changes were divided by the number of minutes that gastroscopy lasted and then multiplied by 60.

In Study IV only those patients were included whose health was estimated to be so fragile that it was safer to perform preparation and colonoscopy in hospital. Outpatients were excluded. Because of the contraindications for NaP and PEG, patients with chronic renal failure (serum creatinine level over 200 $\mu\text{mol/l}$), with massive ascites, severe congestive heart failure or recent myocardial infarction were excluded. Altogether 72 patients participated in the study (NaP 37/ PEG 35), eight were excluded because of inadequate records or tests. The patients randomised to the NaP group drank at least 240 ml clear liquids before they received 45 ml of NaP mixed with 120 ml of water followed by at least 240ml of clear liquids at 7 a.m. on the day before colonoscopy. During the day the patients received 720 ml of clear liquids and at 7 p.m. they ingested an additional 45ml of NaP mixed with 120ml water followed by at least 540ml of clear liquids. The amount of liquids was at least 2070 ml. If colonoscopy was performed in the afternoon, the first dose was given in the evening before and the second on the morning of the examination. The patients randomised to the PEG group received at least four litres of PEG lavage solution before colonoscopy during the two previous days. The preparation was concentrated on the evening before the examination. If colonoscopy was performed in the afternoon, patients also received PEG in the morning of the examination.

Blood tests consisted serum electrolytes, hematocrit and creatinine. Weight, postural pulse and blood pressure were checked, and the clinical indicators of dehydration were measured before and after the bowel preparation.

In Study V 92 consecutive patients living at home and visiting the geriatric outpatient department of Tampere City Hospital and 73 residents of institutions including old people's homes and nursing homes were included. A 17-item postal questionnaire was used. Only patients not suffering from significant dementia (MMSE <21/30) were included.

4.4 Statistical analyses

In Study I comparisons between the distributions of the groups were made using Pearson's chi square test. If frequencies were small, Fisher's exact test was used. In Study III Mann Withney U test was used to assess the significance of any difference between the groups in the frequency of those with arrhythmias. The pre-, per- and postgastroscopy periods were analysed using the Wilcoxon matched pairs signed ranks test. In Study IV Wilcoxon's signed rank test was used to compare the results of blood tests. Mann Withney U test was used to assess the difference between the groups in the change of postural blood pressure and total body weight during the preparation. Non parametric tests were used because most of the data had skewed distributions. In Studies IV and V Chi square test or two-sided Fisher's exact test was used to analyse the categorised data.

5 RESULTS

5.1 Peptic ulcer disease in very old patients

An ulcer was found in 73 (18%) cases. 65 of those were included in the study. The mean age of the patients was 88 (80–95) years. Men (11) were outnumbered by women (54). The majority of patients (58) were assisted by a home help or a nurse and lived at home (51) or in institutions (14). On average, the patients were taking 6 different drugs, 31 (48%) were taking ASA and 18 (28%) NSAIDs. 27 (40%) of the patients were taking neither ASA nor NSAIDs. The ulcers were divided almost evenly between duodenal (31) and gastric (34) ulcers. *H. pylori* was detected only in less than half (35%) of the cases. The patients with *H. pylori* positive ulcers received ASA more often than the others. Seven (23%) patients with duodenal ulcer were *H. pylori* negative and received neither NSAIDs nor ASA, respectively 5 (38%) with a gastric and 7 (33%) with a prepyloric ulcer. Use of ASA or NSAIDs had no effect on the locations of the ulcers. Concomitant use of ASA and NSAIDs was most common among the patients suffering from duodenal ulcer. ASA and NSAIDs were not significantly associated with anaemia or with epigastric pain, although the percentage of those suffering pain was a little lower (57%) among the NSAIDs users compared to those without ASA and NSAIDs (73%).

The most common symptoms in patients suffering from ulcers were: epigastric pain (74%), nausea (23%), vomiting (20%), gastroesophageal reflux (9%) and weight loss (8%). Those who had an *H. pylori* positive ulcer suffered more often from epigastric pain compared to others (91% vs. 64%, $p = 0.02$). Complications occurred in 45 (69%) patients. The most common complications related to peptic ulcers were anaemia (34%), deterioration of health (32%), nausea (23%) and vomiting (19%). Anaemia and vomiting were most common among patients suffering from duodenal ulcers, whereas nausea was prevalent in prepyloric ulcers. However, the *H. pylori* status and the location of the ulcer had no significant effect on the complications.

5.2 Reasons for and outcome of gastroscopy in patients aged 85 years or more

The mean age of the patients was 89 (85–101) years. 132 examinations were performed on women and 22 on men. The majority of the patients (111) lived at home, but were inpatients (110) when gastroscopies were performed. Patients had many concomitant diseases. For example, about 50% of the patients had ischaemic heart disease. Only one indication seldom led to gastroscopy; in more than half of the cases there were two or more indications. Examinations were usually made only after an objective finding like anaemia was identified. For more than half of the cases the reason for acute hospitalisation was also an indication for gastroscopy. The main indications for gastroscopy were epigastric pain (54%), anaemia (36%), vomiting (14%) and nausea (13%). Gastroscopy was successful in 96% of the cases. Of 190 gastroscopies only 7 failed because of patients' lack of cooperation. Only two endoscopies gave normal results. The major clinical findings at gastroscopy were gastritis (67%), oesophagitis (31%) and peptic ulcer disease (25%). Endoscopy revealed the diagnosis explaining patients' symptoms in 60% of cases. After gastroscopy the medication was changed in over three quarters of patients.

5.3 Effect of gastroscopy on cardiopulmonary changes in very old patients

The mean age of the patients was 87 (80–94) years. One patient with chronic obstructive pulmonary disease had significant arterial oxygen desaturation (74%) and angina pectoris associated with gastroscopy. No other clinically significant complications were observed during the procedures.

Each of the 30 patients studied had SVES and about half of the patients had SVT. No significant difference was found between pre-, per- or postgastroscopy periods with supraventricular arrhythmias.

Almost all of the patients had VES during the 24 hour recording. Comparison of the bigeminias or trigeminias in different periods and VES on pre- and postgastroscopy periods showed no significant difference. However, there were significantly more VES in the one-hour period after gastroscopy among the patients suffering from heart disease ($p = 0.007$) and among the patients who had an ST level change of over 1mm one hour after

gastroscopy ($p = 0.01$). During the 24-hour recording five (15%) patients had VT, all of them suffered from heart disease. Three of these also had VT during gastroscopy, one of the patients had VT only during gastroscopy.

During gastroscopy ST changes were greatest or equal to this in 16 (48%) patients. Only eight patients had over 1 mm ST level change, two of these had over 2 mm ST level change. The influence of ST level change on the incidence of arrhythmias was significant only with postgastroscopy VES.

5.4 Bowel preparation for colonoscopy in very old patients

The mean age of the patients was 84 (80–93) years. Sixty seven (93%) of the 72 patients were able to complete the whole preparation. One (3%) patient in the NaP group and four (11%) patients in the PEG group ($p = 0.14$) were unable to complete the preparation. The most common indications for colonoscopies in both groups were anaemia, diarrhoea, abdominal pain and change in bowel habits.

Patients' evaluations of the ease of completing the preparation (Figure 1), of the willingness to repeat the preparation (Figure 2) and of taste (Figure 3) showed no statistically significant difference between the groups.

Patients in the NaP group had more adverse effects during preparation but nausea was the only adverse effect that differed significantly ($p = 0.01$) between the groups. It was graded moderate or severe in 32% of patients in the NaP group compared to 15% of patients in the PEG group. Assessment of the clinical indicators of dehydration before and after the preparation showed a difference only in tongue dryness. In the NaP group more patients had dryer tongue after preparation than before it compared to the PEG group ($p = 0.02$). In other indicators (dryness of the mucous membranes, upper body muscle weakness, confusion, difficulty with speech and sunken eyes) there was no difference.

Laboratory tests for serum potassium and sodium levels in the NaP group and for serum creatinine in the PEG group showed significant changes. In the NaP group serum sodium rose from 142mmol/l to 145mmol/l ($p = 0.003$) and serum potassium fell from 4.0mmol/l to 3.7mmol/l ($p > 0.002$). In the PEG group serum creatinine fell from 97 μ mol/l to 90 μ mol/l ($p = 0.02$). Before preparation two patients in the NaP group and one in the PEG group had potassium values outside the normal range and after preparation eight in the NaP group compared to four in the PEG group.

No significant postural blood pressure change was observed. Weight dropped more often in the patients in the NaP group and the amount of weight drop was also greater in the NaP group compared to the patients in the PEG group.

There were no statistically significant differences in adverse effects between the groups during colonoscopy. The endoscopists' rating of the quality of preparation demonstrated equal results in both groups (Figure 4).

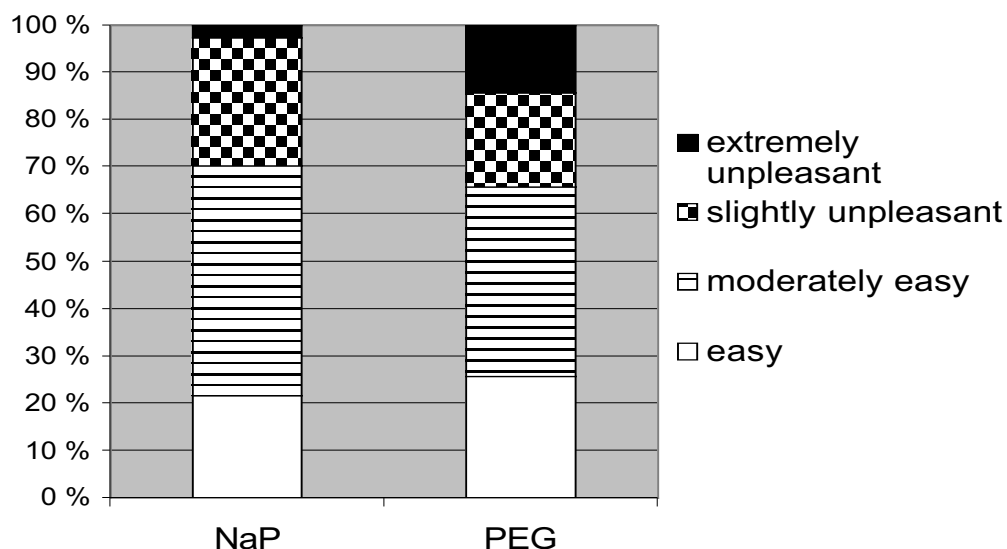


Figure 1. Tolerance of preparation.

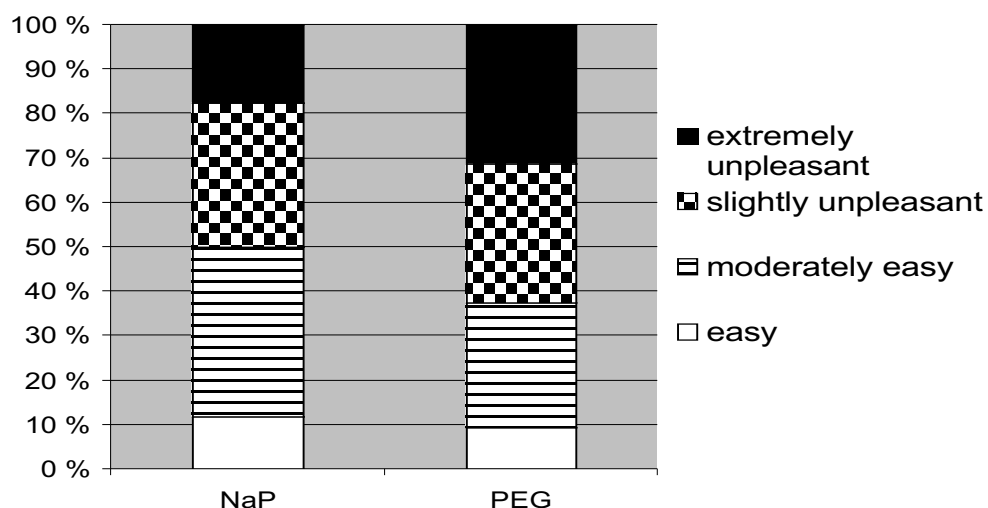


Figure 2. Willingness to repeat the regimen received.

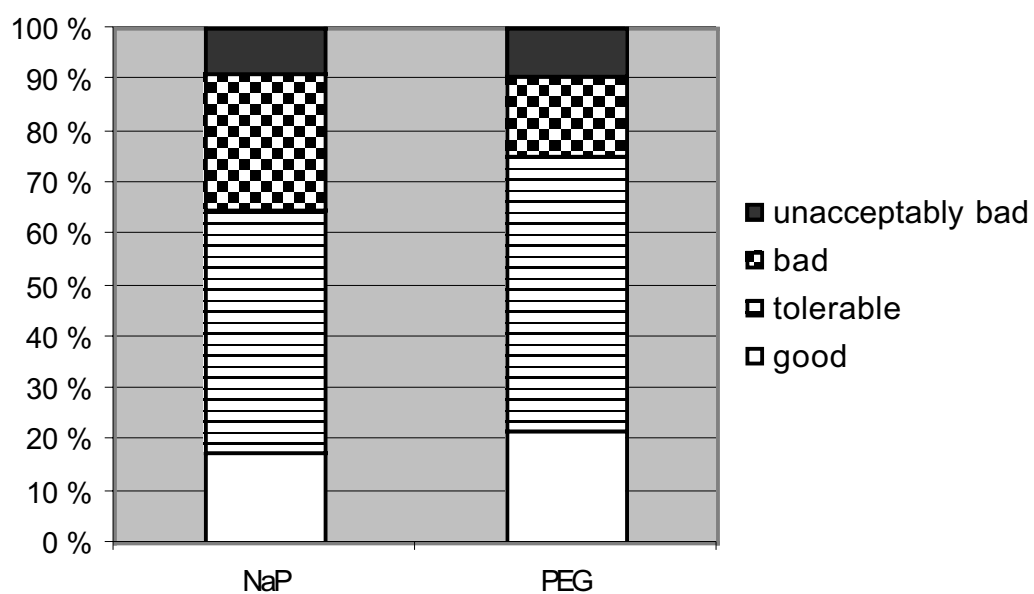


Figure 3. Taste of the preparation used.

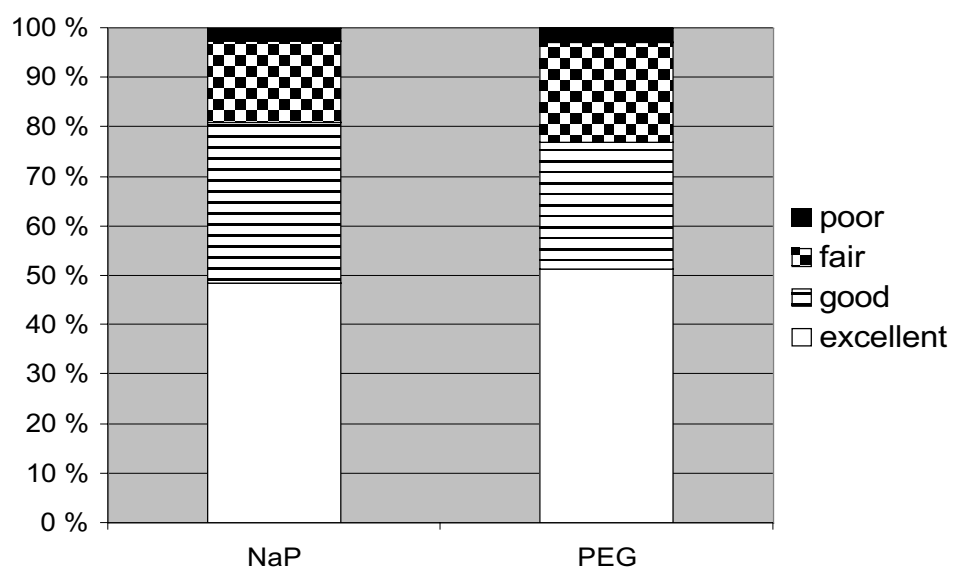


Figure 4. Colonoscopists' ratings of the quality of the preparations.

5.5 Attitudes of elderly patients to examinations and treatments of gastrointestinal symptoms

The mean age of the people studied was 84 (70–104) years. Men (31) were outnumbered by women (134). 94 subjects had had previous gastroscopy and 53 colonoscopy. 49 (30%) of the people studied reported that they had suffered from daily upper abdominal complaints and 49 (30%) had had lower abdominal complaints. No significant difference was found for sex or different age groups. Interestingly, however, 38% of the youngest group had suffered from lower abdominal symptoms during the last three months compared with 18% in the oldest group ($p = 0.06$). The impression of endoscopies was almost equal. 71 (45%) of the people studied considered gastroscopy easy or moderately easy, while 66 (40%) considered colonoscopy easy or moderately easy. The impression of the older groups of endoscopies was more inconvenient than in the younger group, but a significant difference was found only between the groups of people aged 70–79 years and 80–89 years.

133 (81%) of people studied reported that they would wish for proper examinations and treatments if they had upper gastrointestinal problems and 136 (82%) in the case of lower gastrointestinal problems. Table 6. The oldest group tended more often to prefer treatments without examinations than the others. Still, the majority of the extremely old wanted to be properly examined and treated. If the examination needed were either gastroscopy or colonoscopy, three quarters reported willingness for endoscopy. For gastroscopy willingness diminished with age; from the youngest to the oldest group percentages were 85%, 73%, and 66%. The results for colonoscopy were 85%, 80%, and 66%, respectively. Abdominal symptoms had no significant influence on willingness for endoscopy or on the opinion of examinations or treatments.

Table 6. Opinions of patients by age regarding examinations and treatments of gastrointestinal problems. (% in rows)

Patients' age in years	No examinations and no treatment		Treatment without examinations		Examinations and treatment	
	upper	lower	upper	lower	upper	lower
70–79 (n=48)	0	1 (2%)	4 (8%)	3 (6%)	44 (92%)	4 (92%)
80–89 (n=79)	2 (3%)	2 (3%)	15 (19%)	11 (14%)	62 (79%)	6 (84%)
>90 (n=38)	4 (11%)	4 (11%)	7 (18%)	8 (21%)	27 (71%)	6 (68%)

6 DISCUSSION

6.1 Study population

In out of a total Finnish population of 5 181 115, those aged over 80 amounted to 177 128 (3.4%) (Statistics Finland 2002). It is estimated that in 2010 the total population will be about 5 268 000, an increase of 1.7%. At the same time the number of people aged 80 years or more will increase by 33%, to about 236 000 people. The number of people aged 90 years or more in 2000 was 22 637 and the estimate for 2030 is over 49 000, an increase of 218%. How to examine and treat such old patients is a question which will be debated more and more frequently.

In studies on elderly patients the age of the patients usually is 65 years or more, but the mean age tends to be at most between 70 and 80 years. In Finland the age of the patients in geriatric clinics usually is over 80 years, but the number of those aged 90 years or even 100 years is increasing. The mean age of the patients in the Geriatric Department of Tampere City Hospital and in the services for elderly people was slightly over 83 years on June 2002. A common question in geriatric clinics is how in our daily practice we can apply the results of studies in which the oldest patients are younger than our younger patients. In many studies patients with several concomitant diseases and several drugs are excluded. Very few patients are left to draw conclusions. Unfortunately, studies with very old or extremely old patients are rare. In the present studies the mean age of the patients varied from 84 to 89 years. Most patients had concomitant diseases. They had many medications and lived at home. Many of them were assisted by a home help or nurse. Compared with the previous studies only few have had such old populations as in these studies; most were conducted on younger populations. In this study, one of the main goals was to study those patients who are encountered in daily geriatric practice. Due to this, the results of the studies may not necessarily be generalizeable to the whole group of very old people.

6.2 Results

6.2.1 Abdominal complaints and the use of examinations and treatments of the gastrointestinal tract

Abdominal complaints were common among the people studied. Despite the high age of participants, the vast majority of them wanted to be properly examined and treated, even in the group of the oldest old. Uncertainty regarding one's own health affects most people, regardless of age. This study shows the desire of very old people to be properly examined. Untreated diseases or many drugs used for uninvestigated symptoms are not likely to enhance either length or quality of life.

Even though patients are willing to be examined with different procedures, it is appropriate to consider their use. Is it reasonable at all to perform endoscopies or other stressful procedures on such old patients? In previous studies the outcome of endoscopies in the very old has been very good, so this is not a reason to refrain from performing them (Lockhart et al. 1985, Brussaard and Vandewoude 1988, Keyriläinen and Sipponen 1997). What about life expectancy? For example, in Study III the mean age of the patients studied was very high, and still 40% of the patients were alive four years after gastroscopy. Estimation of life expectancy and especially quality of life in an individual is difficult.

6.2.2 Gastroscopy

Gastroscopy is regarded by most patients as an unpleasant examination. In these studies gastroscopy was found to be safe and well tolerated and it had a high diagnostic yield. Failures in the examinations were due to lack of cooperation caused by dementia. These results are concur with previous studies on elderly patients (Gibbins et al. 1974, Lockhart et al. 1985, Cooper and Neumann 1986, Brussaard and Vandewoude 1988, Clarke et al. 2001). The comparison of indications between the studies is difficult due to different definitions and practices. However, many indications include overlapping features. If these facts are taken into consideration, no major difference is found. This may be applied to the findings, too.

No fatal complication associated with gastroscopies occurred in the studies. The number of patients was too small to evaluate the overall risk caused by gastroscopy, but in this study only patients with heart diseases had significant ECG changes induced by gastroscopy. This finding is in accordance with previous studies (Mathew et al. 1979,

McAlpine et al. 1990), in which patients with heart diseases were at increased risk of complications. The occurrence of different arrhythmias during gastroscopy varies greatly between studies. Although our patients were older than those in previous studies (Pyörälä et al. 1973, Mathew et al. 1979, Bowling et al. 1993, Strandberg et al. 1993, Wilcox et al. 1993), the results of present study were located in the middle of these. Very old patients had numerous arrhythmias during the 24-hour recordings. The number of patients who had serious arrhythmias was almost equal during the different time periods observed. An increase of 2% after the examination has no clinical importance because of the great normal variance of arrhythmias. Therefore gastroscopy may be regarded as a safe examination even for very old patients.

6.2.3 Peptic ulcer disease

As in other studies with elderly or with very old symptomatic patients, ulcer was also a common finding of the gastroscopy in this study (Gibbins et al. 1974, Lockhart et al. 1985, Cooper and Neumann 1986, Brussaard and Vandewoude 1988, Clarke et al. 2001). This may be due to two reasons: the incidence of peptic ulcer disease is high, and the use of gastroscopy is cautious in the elderly. The sites of the ulcers were also evenly divided between the duodenum and the gastric in contrast to younger age groups. Other gastric ulcers were outnumbered by prepyloric ulcers. This feature has been observed in younger elderly as well (Clinch et al. 1984, Wyatt et al. 1992). NSAIDs are thought to be associated especially with prepyloric ulcers (Brody et al. 1992). Among the patients studied the use of NSAIDs and ASA was common. The patients used ASA mostly for the treatment of cerebrovascular and heart diseases. As the mean age of the population increases the prevalence of these diseases will be greater and the number of patients receiving ASA will increase in the near future. The use of ASA or NSAIDs had no significant effect on the location of the ulcers in this study. The patients with a prepyloric ulcer did not use ASA or NSAIDs more often than the others.

Epigastric pain was the most common symptom; nearly three quarters suffered from it. In this study, all kinds of pain located in the epigastric abdomen were accepted as epigastric pain and the patients were observed for a few days before gastroscopy was performed. This may explain the higher prevalence of patients suffering from epigastric pain.

More than a half of the patients with ulcer had no detectable *H. pylori* infection. This concurs with the previous findings in which only the use of NSAIDs correlates significantly

with ulcer incidence in patients aged 70 years or more (Wyatt et al. 1992). The number of H. pylori negative ulcers in the elderly is growing, and even more so in the very old. As the H. pylori infection was diagnosed only from biopsies some infections may have remained unnoticed. Usually, most H. pylori negative ulcers are associated with the use of NSAIDs. In this study only one third of H. pylori negative patients used NSAIDs. If ASA is included, the corresponding percentage is 55, which comes very close to the results of the previous studies (Gilinsky 1988, Brody et al. 1992).

As in other studies (Chan et al. 1997, Voutilainen et al. 2001), it seems that like other NSAIDs, ASA has a significant effect on the development of ulcer in the elderly, especially in H. pylori positive patients. This study supports the idea that at least for an elderly H. pylori infected patient it is recommendable to eradicate H. pylori before starting a long term ASA treatment.

6.2.4 Colonoscopy

Colonoscopy was also a safe examination, no serious complications associated with it occurred. As in other studies, patients were able to complete NaP preparation more often than PEG preparation (DiPalma and Marshall 1990, Marshall et al. 1993b, Afridi et al. 1995, Young et al. 2000). Compared to some other studies PEG preparation was slightly easier to complete in our study (Chatrenet et al. 1993, Vanner et al. 1990, Golub et al. 1995, Afridi et al. 1995, Clarkston et al. 1996).

The facts that patients considered the taste of NaP worse and had nausea more often during the preparation with NaP than with PEG did not affect the opinion that NaP preparation is easier to perform and willingness to repeat the preparation is better with it. In the study by Young et al. (2000), patients in the NaP group reported more unpleasant symptoms during the preparation than in the PEG group but as in other studies, no significant difference was found regarding adverse effects (Vanner et al. 1990, Cohen et al. 1994, Afridi et al. 1995, Golub et al. 1995, Clarkston et al. 1996, Aronchick et al. 2000).

The safety of preparation was assessed to be better in the PEG group. As in other studies, PEG caused less change in the indicators of dehydration and in laboratory tests (Vanner et al. 1990, Cohen et al. 1994, Aronchick et al. 2000). In a group of such old patients with heart diseases the fall in the values of serum potassium from normal to abnormal range gives rise to concern about increased cardiopulmonary complications. In Clarkston's study (1996), however, no increase in serious arrhythmias was detected.

Preparation had no effect on how colonoscopy succeeded, on adverse effects and on the quality of the preparation. These results are in agreement with studies on younger patients (Afridi et al. 1995, Golub et al. 1995, Clarkston et al. 1996, Aronchick et al. 2000). In this study all the patients were inpatients and nurses prompted them to drink enough clear liquids, which is crucial for the quality of NaP preparation.

Patients' opinions favoured NaP preparations. NaP had more other adverse effects, but the difference from PEG was minor. In patients at risk of hypokalemia it is advisable to monitor the levels of serum potassium before and after preparations, especially with NaP. Neither NaP nor PEG preparation was found clearly superior in patients aged 80 years or more. PEG preparation is more recommendable for those elderly patients who are vulnerable to complications caused by electrolyte disturbances. If NaP preparation is used the amount of clear liquids should be at least 2.5 litres.

7 CONCLUSIONS

1. Gastrointestinal complaints are common in very old patients. The majority of elderly patients want to be properly examined and treated if they had gastrointestinal problems.
2. Gastroscopy is well tolerated and it has a high diagnostic yield in symptomatic very old patients. Gastroscopy revealed a diagnosis in more than half of the cases, and medication was changed in more than three quarters of cases.
3. Peptic ulcer is a common finding in gastroscopy in very old patients. The most common symptoms in patients suffering from ulcers are: epigastric pain, nausea and vomiting. Complications are also common and occurred in 69% of patients. Most peptic ulcers are associated with the use of NSAIDs or ASA and H. pylori infection. However, almost one third of patients aged 80 years or more had none of these exposures.
4. During gastroscopy no significant increase was observed in ventricular or in supraventricular arrhythmias. There was significantly more VES in the one-hour period after gastroscopy in patients suffering from heart disease and in patients who had an ST level change of over 1mm hour after gastroscopy.
5. Colonoscopy is a safe examination for old patients. No serious complications occurred during the preparations and colonoscopies. Patients' evaluations and endoscopists' ratings of the preparations showed no statistically significant difference between the NaP and the PEG groups. Levels of serum potassium fell and levels of serum sodium rose in the NaP group and levels of serum creatinine rose in the PEG group. These changes were statistically significant.
6. According to this dissertation “Gastroscopy and colonoscopy in very old patients” discrimination against elderly patients because of their age is not based on fact.

8 SUMMARY

Gastroscopy and colonoscopy have become the gold standard in investigating abdominal complaints. In this study the use of gastroscopy and colonoscopy in very old patients was studied. Peptic ulcer disease was studied as an example of common disease of the gastrointestinal tract in the very old.

In order to study peptic ulcer disease files from the 408 diagnostic gastroscopies performed on patients aged 80 years or more in the geriatric department of the Tampere City Hospital were reviewed. Ulcer was found in 73 (18%) cases. The ulcers were divided almost evenly between duodenal and gastric ulcers. *H. pylori* was detected in only less than half of the cases. The most common symptoms were epigastric pain, nausea and vomiting. An ulcer caused complications in 69% of patients.

The reasons for and the outcome of gastroscopy in patients aged 85 years or more were studied from 191 diagnostic gastroscopies. For more than half of the cases the reason for acute hospitalisation was also an indication for gastroscopy. The main indications for gastroscopy were epigastric pain (54%), anaemia (36%), vomiting (14%) and nausea (13%). The major clinical findings at gastroscopy were gastritis (67%), oesophagitis (31%) and peptic ulcer disease (25%). Endoscopy revealed the reason for patients' symptoms in 60% of cases, and after gastroscopy medication was changed in more than three quarters of patients.

Gastroscopy was a safe examination according to the studies; no deaths associated with it occurred. Very old patients had numerous arrhythmias during 24-hour ECG the recordings, but during gastroscopy no increase in these was observed. However, there was an increased number of VES after endoscopy in patients suffering from heart disease.

Optimal bowel preparation for colonoscopy was studied in very old patients by randomizing seventy-two patients aged 80 years or more to receive either NaP or PEG preparation. NaP and PEG preparations were almost equally tolerated and effective in very old inpatients. PEG preparation was assessed to be safer than NaP. It caused fewer changes in the clinical indicators of dehydration and in laboratory tests. Endoscopists evaluated the quality of preparation as good or excellent in 81% of cases in the NaP group and in 77% of cases in the PEG group. No clinically significant adverse effects occurred during the preparations or colonoscopies.

The attitudes of 165 elderly patients to the examinations and treatments of gastrointestinal symptoms were assessed by using a 17-item postal questionnaire. Abdominal complaints were common among participants. Despite the high age of the participants, the vast majority (>80%) wanted to be properly examined and treated, even in the group of oldest old.

With advancing age many gastrointestinal diseases become more prevalent. In these studies elderly patients also frequently had abdominal symptoms. The majority of the oldest old were willing to undergo examinations and the diagnostic yield of the endoscopies was good. Endoscopic examinations were safe, no serious complications occurred. On the basis of this study gastroscopy and colonoscopy can be considered as safe and useful examinations in very old patients.

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APPENDIX

Questionnaire to respondents in various age groups on abdominal symptoms and their diagnosis

As part of a wider research project we are researching abdominal problems among people of different ages and their impressions of the gastrointestinal endoscopies used in tests. The questions concern abdominal problems you have experienced and your own conception of the way you would like these to be investigated and treated.

Gastrointestinal endoscopies refers in the present study to both gastroscopy of the upper abdomen and colonoscopy of the large intestine. Gastroscopy is performed by means of a thin flexible tube inserted through the mouth either with or without a local anaesthetic of the throat. The most common reasons for this procedure are: pains in the upper abdomen or behind the thorax, nausea, vomiting or anaemia. Typical findings with gastroscopy include gastric or duodenal ulcer, inflammation of the oesophagus or malignant change (e.g. cancer), and gastric catarrh. Colonoscopy is performed anally after preparation of the intestine using a flexible tube. The most common reasons for this procedure are anaemia, abdominal pain, changes in the functioning of the stomach and persistent diarrhoea.

We would request you to respond carefully to all the following questions. Questionnaires are completed anonymously, and the information they contain will not be traceable to you. Thank you for participating and giving of your time!

Tampere 14th of December 2001

Lauri Seinela
Senior Physician

Jari Ahvenainen
Chief Physician

14. Which of the following best corresponds to your conception of colonoscopy? Please respond whether or not you have undergone this procedure.

1 easy 2 fairly easy 3 fairly difficult 4 difficult

15. Have you experienced continuous pain lately (3months) in the lower abdomen?

0 yes 1 no

16. It is recommended that continuous pain in the lower abdomen, continuous diarrhoea, haemorrhage from anus and anaemia in people over the age of 45 should be investigated using colonoscopy. If you had such symptoms in the lower abdomen would you wish it to be investigated according to the recommendations with colonoscopy regardless of your age? (Please answer even if you do not have such pain.)

0 yes 1 no

If you answered 'no', please briefly give your reasons.

17. Which of the following alternatives best corresponds to your conception of the way you would like the situation to be handled if you had continuous symptoms in the lower abdomen?

0 no treatment and no tests

1 medication without tests or positive diagnosis (this alternative includes the possibility that you would receive incorrect or pointless treatment, e.g. unnecessary medication. It could also delay an exact diagnosis)

2 appropriate tests and if necessary treatment according to the recommendations

ORIGINAL PUBLICATIONS